IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Reissue Application for	
U.S. Patent No. 5,870,527 issued February 9, 1999	
Inventors: TAKAYUKI FUJIKAWA ET AL.	Attn: Applications Branch
Reissue No. (Unassigned)	
Title: ROBOT CONTROL METHODS AND APPARATUS	

PRELIMINARY AMENDMENT AND STATEMENT OF STATUS/SUPPORT FOR ALL CHANGES TO THE CLAIMS

ASSISTANT COMMISSIONER FOR PATENTS
Box NEW REISSUE APPLICATION
Washington, D.C. 20231

Sir:

This Preliminary Amendment is being filed concurrently with the above-referenced Reissue Application, in accordance with 37 CFR 1.173(b). Please amend the specification and claims of the application as follows:

IN THE SPECIFICATION:

Please amend the paragraph at column 4, lines 49 to 53, as follows:

-- The status transition preparation portion 140, path selection portion 142, arc selection portion 144, and data transmission portion 146 shown in FIG. 3 are stored in the ROM of the control [conntrol] circuit 14 and are executed by the microprocessor of the control circuit 14. --

Please amend the paragraph at column 4, lines 58 to 63, as follows:

-- The status transition preparation portion 140 sets the states passed through from the state at the start of the operation of the robot 1 (starting state) to the state at the end of the operation (target state) and prepares a status transition chart (FIG. 4 etc.) as an operational state model based on the set states and the operational arcs at the time of transition between states. --

Please amend the paragraph at column 8, lines 62 to 64, as follows:

-- When the value v of the uniform [unifoorm] random number is in the range of $s_k \leqq v < e_k$, the operational arc A^k_{ij} corresponding to the value v of the uniform random number is selected. --

Please amend the paragraph at column 9, lines 31 to 35, as follows:

-- FIG. 9 is a view of the operational arcs determined [determtned] by the status transition preparation portion 140, path selection portion 142, arc selection portion 144, and data transmission portion 146 based on the status transition chart shown in FIG. 8. --

Please amend the paragraph at column 9, lines 41 to 46, as follows:

-- However, when the starting state S_S and the target state S_G match, the series of self operational arcs A^k_{GG} is produced. At this time, the operating data corresponding to the series of

operational arcs A^{k}_{GG} is not supplied to the drive portions 120a to 120d. In this case, the state is not particularly changed and therefore useless processing can be eliminated. --

Please amend the paragraph at column 10, lines 42 to 45, as follows:

-- Further, according to the methods and apparatus for control of a robot of the present invention, it is possible to increase the number of matters [matter] expressable by the operations of the robot. --

IN THE CLAIMS:

Please amend claims 3 to 5 as follows:

3. (Amended) A robot control method as set forth in claim 1, wherein said [operational arc includes a] self operational arc shows [showing] the operation of said robot when returning from one state among the plurality of states to the same one state.

4. (Amended) A robot control apparatus for controlling the operation of a robot having a plurality of states corresponding to a predetermined operation,

at least one operational arc being determined between each of any two directly passable states among said plurality of states showing the operation of the robot when passing between said two states, comprising a weighting means for giving to each of the

determined arcs of operation a weighting coefficient corresponding to the probability of that operational arc being selected,

an operational arc selecting means for selecting based on probability one of said operational arcs between said two states when making the operation of the robot pass between said two states based on said weighting coefficients of the operational arcs between said two states,

an operating data producing means for producing along with time operating data corresponding to the operation of said robot shown by said selected operational arc, and

controlling means for controlling the operation of the robot based on said produced operating data,

wherein said operating data producing means suppresses the production of said operating data corresponding to a [said] self operational arc before a [said] transition in state and after said transition in state when the states of the robot before the transition of state and after the transition of state coincide.

5. (Amended) A robot control apparatus as set forth in claim 4, wherein said [operational arc includes a] self operational arc shows [showing] the operation of said robot when returning from one state among the plurality of states to said same one state.

Please add new claims 6 to 18 as follows:

6. (Newly added) A computer-readable medium containing a program for controlling the operation of a robot so as to pass through a plurality of states corresponding to a predetermined operation, the program comprising the steps of:

determining at least one operational arc between two directly passable states among the plurality of states showing the operation of said robot when passing between the two states;

giving to each of the determined operational arcs a weighting coefficient corresponding to the probability of that operational arc being selected;

selecting on a probable basis one of said operational arcs between said two states when making the operation of the robot pass between said two states based on said weighting coefficients of the operational arcs between said two states;

controlling the robot so as to perform the operation shown by the selected operational arc when making the operation of the robot pass between said two states; and

controlling the robot so as to return to a first of said two states, said operational arc including a self operational arc showing the operation of said robot when returning to the first state.

7. (Newly added) A recording medium having recorded thereon a program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:

selecting one operation based on a predetermined probability from among operations described in an operational state model that describes operational states of said robot; and

controlling said drive portions so as to perform the selected operation.

8. (Newly added) A recording medium having recorded thereon a program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:

defining, in a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states;

giving to each of the defined operational arcs a predetermined weighting coefficient;

determining, when passing from a first state to a second state from among the plurality of states, a single transition path based on the weighting coefficients of attainable transition paths; and

controlling, based on the determined transition path, said robot so as to move from the first state to the second state.

9. (Newly added) A program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:

randomly selecting one operation from among operations described in an operational state model that describes operational states of said robot; and

controlling said drive portions so as to perform the selected operation.

10. (Newly added) A program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:

defining, in a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states;

giving to each of the defined operational arcs a predetermined weighting coefficient;

determining, when passing from a first state to a second state from among the plurality of states, a single transition path based on the weighting coefficients of attainable transition paths; and

controlling, based on the determined transition path, said robot so as to move from the first state to the second state.

11. (Newly added) A robot for performing predetermined operations, said robot having drive portions, comprising:

storage means for storing an operational state model that defines operational states of said robot; and

operation control means for selecting one operation based on a predetermined probability from among operations described in said operational state model and for controlling said drive portions so as to perform the selected operation.

12. (Newly added) A robot according to claim 11, wherein:

said operation state model includes a plurality of states;

between each of any two directly passable states, at least one operational arc showing the operation of said robot when passing between the two states is defined; and

the defined operational arcs are each given a transition probability of the operational arc being selected.

13. (Newly added) A robot according to claim 12, wherein:

the operational arcs include a self-operational arc showing the operation of said robot when returning to a first state of said two states.

14. (Newly added) A robot according to claim 12, wherein the transition probabilities are changeable.

15. (Newly added) A robot for performing predetermined operations, said robot having drive portions, comprising:

storage means for storing a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot;

wherein, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states is defined;

the defined operational arcs are each given a predetermined weighting coefficient; and

control means for determining a single transition path when passing from a first state to a second state from among the plurality of states, based on the weighting coefficients of attainable transition paths.

16. (Newly added) A robot according to claim 15, wherein the weighting coefficients are dynamically changeable.

17. (Newly added) A robot control method for controlling a robot for performing predetermined operations, said robot having drive portions, said robot control method comprising the steps of:

selecting one operation based on a predetermined probability from among operations described in an operational state model that describes operational states of said robot; and

controlling said drive portions so as to perform the selected operation.

18. (Newly added) A robot control method for controlling a robot for performing predetermined operations, said robot having drive portions, said robot control method comprising the steps of:

defining, in a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states;

giving to each of the defined operational arcs a predetermined weighting coefficient;

determining, when passing from a first state to a second state from among the plurality of states, a single transition path based on the weighting coefficients of attainable transition paths; and

controlling, based on the determined transition path, said robot so as to move from the first state to the second state.

STATEMENT

The following statement of the status and support for all changes to the claims in this reissue application is provided to comply with 37 CFR 1.173(c) and to facilitate the Examiner's consideration of this reissue application.

Claims 1 to 5 were issued in the original patent, and remain pending in this reissue application. Claims 3, 4 and 5 have been amended, and new claims 6 to 18 have been added to this reissue application by the foregoing amendment. Thus, claims 1 to 18 are currently pending.

Claim 3 was amended to change the phrase "said operational arc includes a self operational arc showing" into --said self operational arc shows--. This amendment was made to make claim 3 consistent with the language of claim 1 from which claim 3 depends. Specifically, the last paragraph of claim 1 includes the phrase "said operational arc includes a self operational arc." Therefore, claim 3 cannot properly introduce "a self operational arc" as a new element in the claim. Support for this amendment is believed to be self-evident from the language of claims 1 and 3.

Claim 4 was amended to change the phrases "said self operational arc" and "said transition in state" in the last paragraph, into --a self operational arc-- and --a transition in state--, respectively. These amendments were made because these elements of the invention are being introduced for the first time in claim 4 and do not otherwise have an antecedent basis in the claim. Support for this amendment is believed to be self-evident from the language of claim 4.

Claim 5 was amended to change the phrase "said operational arc includes a self operational arc showing" into --said self operational arc shows--. This amendment was made to make claim 5 consistent with the language of claim 4 from which claim 5 depends. Specifically, the last paragraph of claim 4, as amended, includes the phrase "a self operational arc." Therefore, claim 5 cannot properly introduce "a self operational arc" as a new element in the claim. Support for this amendment is believed to be self-evident from the language of claims 4 and 5.

New claims 6 to 18 have been added to claim additional subject matter to which the Applicants are believed to be entitled. These claims are broader in some aspects, and narrower in some aspects, as compared to the issued claims of the '527 patent. An explanation of the support in the disclosure of the patent for the changes made to the claims is provided in the following chart:

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
6. (Newly added) A computer-readable medium containing a program for controlling the operation of a robot so as to pass through a plurality of states corresponding to a predetermined operation, the program comprising the steps of: determining at least one operational arc between two directly passable states among the plurality of states showing the operation of said robot when passing between the two states; giving to each of the determined operational arcs a weighting coefficient corresponding to the probability of that operational arc being selected; selecting on a probable basis one of said operational arcs between said two states when making the operation of the robot pass between said two states based on said weighting coefficients of the operational arcs between said two states; controlling the robot so as to perform the operation shown by the selected operational arc when making the operation of the robot pass between said two states; and controlling the robot so as to return to a first of said two states, said operational arc including a self operational arc showing the operation of said robot when returning to the first state.	This claim is directed to a computer-readable medium containing a program for controlling the operation of a robot. Support for the computer-readable medium is provided, for example, in column 4, lines 25 to 32, of the '527 patent, which describes the control circuit 14 as having a microprocessor, ROM, RAM, and peripheral circuits required for computations, and a program for realizing the robot control method. Further support for this feature is provided at column 4, lines 50 to 54, which recites that the portions 140-146 of the program are stored in the ROM of the control circuit 14. The program steps recited in claim 6 are the same as the method steps recited in claim 1 of the '527 patent. Therefore, support for these program steps is found, among other places, in claim 1 of the patent.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
7. (Newly added) A recording medium having recorded thereon a program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:	This claim is directed to a "recording medium having recorded thereon a program for controlling a robot for performing predetermined operations." Support for the "recording medium" aspect of this claim is provided, for example, in column 4, lines 25 to 32 and lines 50 to 54, as explained above. Support for "predetermined operations" is provided, for example, in column 4, lines 6 to 17, which describes basic operations of sleeping, sitting, waving, standing, and walking, and operational arcs defined therebetween. Support for the "drive portions" feature is provided, for example, in column 4, lines 21 to 23, which describes drive portions 120a to 120d.
selecting one operation based on a predetermined probability from among operations described in an operational state model that describes operational states of said robot; and	Support for this program step is provided, for example, in column 4, line 55, through column 8, line 33, which describes an "Operation of Status Transition Preparation Portion 140" and a "Operation of Path Selection Portion 142." The "operational state model" recited in this program step corresponds to the "status transition chart" described in column 4, lines 58 to 63. The "predetermined probability" recited in this program step corresponds to the "weighting coefficient corresponding to the probability" described in column 5, lines 2 to 4.
controlling said drive portions so as to perform the selected operation.	Support for this program step is provided, for example, in column 9, line 47, through column 10, line 12, which describe operation of the drive portions 120a to 120d to perform a selected operation based on the operational path determined by the control portion 12.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
8. (Newly added) A recording medium having recorded thereon a program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:	This claim is also directed to "a recording medium having recorded thereon a program for controlling a robot for performing predetermined operations." The preamble of claim 8 is the same as claim 7, which finds support in the patent disclosure as explained above.
defining, in a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states;	Support for the "status transition model" aspect of this program step is provided, for example, in column 4, lines 58 to 63, and in Fig. 4 of the drawings. Support for the "predetermined states" and "predetermined operations" recited in this program step is provided, for example, in column 4, lines 6 to 17. Support for the "operational arcs" recited in this program step is provided, for example, in column 4, lines 12 to 17.
giving to each of the defined operational arcs a predetermined weighting coefficient;	Support for this program step is provided, for example, in column 4, lines 13 to 16.
determining, when passing from a first state to a second state from among the plurality of states, a single transition path based on the weighting coefficients of attainable transition paths; and	Support for this program step is provided, for example, in column 5, line 55, through column 6, line 9.
controlling, based on the determined transition path, said robot so as to move from the first state to the second state.	Support for this program step is provided, for example, in column 10, lines 1 to 12.
9. (Newly added) A program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:	This claim is directed to a program for controlling a robot for performing predetermined operations. Support for "program" is provided, for example, in column 4, line 27, and in Fig. 3.
randomly selecting one operation from among operations described in an operational state model that describes operational states of said robot; and	Support for this program step is provided in column 8, lines 52 to 64, which describes a processing routine using random numbers to select an operational arc.
controlling said drive portions so as to perform the selected operation.	Support for this step is provided, for example, in column 10, lines 1 to 12.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
10. (Newly added) A program for controlling a robot for performing predetermined operations, said robot having drive portions, said program comprising the steps of:	This claim is directed to a program for controlling a robot. The preamble of this claim is the same as the preamble of claim 9. Support for "program" is provided, for example, in column 4, line 27, and in Fig. 3.
defining, in a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states;	Support for the "status transition model" aspect of this program step is provided, for example, in column 4, lines 58 to 63, and in Fig. 4 of the drawings. Support for the "predetermined states" and "predetermined operations" recited in this program step is provided, for example, in column 4, lines 6 to 17. Support for the "operational arcs" recited in this program step is provided, for example, in column 4, lines 12 to 17.
giving to each of the defined operational arcs a predetermined weighting coefficient;	Support for this program step is provided, for example, in column 4, lines 13 to 16.
determining, when passing from a first state to a second state from among the plurality of states, a single transition path based on the weighting coefficients of attainable transition paths; and	Support for this program step is provided, for example, in column 5, line 55, through column 6, line 9.
controlling, based on the determined transition path, said robot so as to move from the first state to the second state.	Support for this program step is provided, for example, in column 10, lines 1 to 12.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
11. (Newly added) A robot for performing predetermined operations, said robot having drive portions, comprising: storage means for storing an operational state model that defines operational states of said robot; and operation control means for selecting one operation based on a predetermined probability from among operations described in said operational state model and for controlling said drive portions so as to perform the selected operation.	This claim is directed to a robot for performing predetermined operations. Support for "robot" is provided in column 4, lines 1 to 8. Support for "drive portions" is provided in column 4, lines 22 to 24. Support for the claimed storage means is provided in column 4, lines 50 to 54, which describes portions 140-146 of a program stored in the ROM of the control circuit 14. The "operational state model" corresponds to the "status transition chart" described in column 4, lines 58 to 63. The "operation control means" corresponds to the path selection portion 142 and arc selection portion 144 of the control circuit 14, which are described in column 4, lines 50 to 54, and in column 5, line 55, through column 8, line 54. The "predetermined probability" corresponds to the "weighting coefficient corresponding to the probability" described in column 5, lines 2 to 4.
12. (Newly added) A robot according to claim 11, wherein: said operation state model includes a plurality of states; between each of any two directly passable states, at least one operational arc showing the operation of said robot when passing between the two states is defined; and the defined operational arcs are each given a transition probability of the operational arc being selected.	The operation state model corresponds to the status transition chart described in column 4, line 58, through column 5, line 9. The status transition chart has a plurality of states and operational arcs, as described in column 5, lines 5 to 9. Support for the "at least one operational arc" is provided, for example, in column 4, lines 12 to 17. Support for the operational arcs being given a "transition probability" is provided, for example, in column 5, lines 10 to 24.
13. (Newly added) A robot according to claim 12, wherein: the operational arcs include a self-operational arc showing the operation of said robot when returning to a first state of said two states.	Support for the self-operational arc is provided, for example, in the last paragraphs of claims 1 and 4, and in the specification at column 2, lines 9 to 11, and column 9, lines 41 to 46.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
14. (Newly added) A robot according to claim 12, wherein the transition probabilities are changeable.	Support for the transition probabilities being changeable is provided in column 10, lines 30 to 33.
15. (Newly added) A robot for performing predetermined operations, said robot having drive portions, comprising:	This claim is directed to a robot for performing predetermined operations. Support for "robot" is provided in column 4, lines 1 to 8. Support for "drive portions" is provided in column 4, lines 22 to 24.
storage means for storing a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot;	Support for the claimed storage means is provided in column 4, lines 50 to 54, which describes portions 140-146 of a program stored in the ROM of the control circuit 14. Support for "status transition model" is provided in column 4, lines 58 to 63. The predetermined states and predetermined operations correspond to the "states" and the operations represented by the "operational arcs" described in column 4, lines 6 to 17.
wherein, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states is defined;	Support for the "at least one operational arc" is provided, for example, in column 4, lines 12 to 17.
the defined operational arcs are each given a predetermined weighting coefficient; and	Support for the operational arcs being given a "predetermined weighting coefficient" is provided, for example, in column 5, lines 10 to 24.
control means for determining a single transition path when passing from a first state to a second state from among the plurality of states, based on the weighting coefficients of attainable transition paths.	The control means corresponds to the control circuit 14 described in column 4, lines 25 to 45, and in column 10, lines 1 to 12.
16. (Newly added) A robot according to claim 15, wherein the weighting coefficients are dynamically changeable.	Support for dynamically changeable weighting coefficients is provided, for example, in column 10, lines 30 to 33.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
17. (Newly added) A robot control method for controlling a robot for performing predetermined operations, said robot having drive portions, said robot control method comprising the steps of:	Support for "predetermined operations" is provided, for example, in column 4, lines 6 to 17, which describes basic operations of sleeping, sitting, waving, standing, and walking. Support for "drive portions" is provided, for example, in column 4, lines 21 to 23, which describes "drive portions 120a to 120d."
selecting one operation based on a predetermined probability from among operations described in an operational state model that describes operational states of said robot; and	Support for this method step is provided, for example, in column 4, line 55, through column 8, line 33, which describes an "Operation of Status Transition Preparation Portion 140" and a "Operation of Path Selection Portion 142." The "operational state model" corresponds to the "status transition chart" described in column 4, lines 58 to 63. The "predetermined probability" corresponds to the "weighting coefficient corresponding to the probability" described in column 5, lines 2 to 4.
controlling said drive portions so as to perform the selected operation.	Support for this method step is provided, for example, in column 9, line 47, through column 10, line 12, which describe operation of the drive portions 120a to 120d based on the operational path determined by the control portion 12.

New Claims Added to Reissue Application	Support in '527 Patent for Claim Changes
18. (Newly added) A robot control method for controlling a robot for performing predetermined operations, said robot having drive portions, said robot control method comprising the steps of:	The preamble of this claim is the same as the preamble of claim 17, which finds support in the patent disclosure as explained above.
defining, in a status transition model that defines a plurality of predetermined states and a plurality of predetermined operations of said robot, between each of any two directly passable states among the plurality of states, at least one operational arc showing the operation of said robot when passing between the two states;	Support for the "status transition model" is provided, for example, in column 4, lines 58 to 63, and in Fig. 4 of the drawings. Support for the "predetermined states" and "predetermined operations" recited in this method step is provided, for example, in column 4, lines 6 to 17. Support for the "operational arcs" recited in this method step is provided, for example, in column 4, lines 12 to 17.
giving to each of the defined operational arcs a predetermined weighting coefficient;	Support for this method step is provided, for example, in column 4, lines 13 to 16.
determining, when passing from a first state to a second state from among the plurality of states, a single transition path based on the weighting coefficients of attainable transition paths; and	Support for this method step is provided, for example, in column 5, line 55, through column 6, line 9.
controlling, based on the determined transition path, said robot so as to move from the first state to the second state.	Support for this method step is provided, for example, in column 10, lines 1 to 12.

The foregoing amendment also includes certain changes to the specification to correct typographical and grammatical errors of a minor nature in the '527 patent. These amendments include: in column 4, line 53, "conntrol" has been changed to --control--; in column 8, line 62, "unifoorm" has been changed to --uniform--; in column 9, line 31, "determtned" has

been changed to --determined--; and in column 10, line 44, "matter" has been changed to --matters--.

The specification was also amended to clarify antecedent bases in the description section of the specification as follows: in column 4, line 62, the phrase --as an operational state model-- has been inserted after "status transition chart" to provide antecedent basis for the same phrase used in the claims; and in column 9, line 42, the term --self-- has been inserted before "operational" to provide antecedent basis for the "self operational arc" recited in claims 1, 3, 4, 5, and 13. All amendments to the specification have been presented in the form of rewritten paragraphs with changes shown by brackets and underlining, in accordance with 37 CFR 1.173(b).

In light of these amendments and the accompanying remarks, prompt and favorable examination of this reissue application is respectfully requested.

Respectfully submitted,

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